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ABSTRACT

A questionnaire was constructed for the purpose of investigating various aspects of the career choices made by graduate students. The research was to determine the underlying structure of the questionnaire and to compare the capability of nonmetric multidimensional scaling (MDS) and linear factor analysis (FA) to reveal dimensions measured by the instrument. The FA and MDS methodologies succeeded in meeting the research objectives. Both methods identified the same items for possible deletion and yielded results which could be interpreted as providing evidence to support the construct validity of the instrument. The factor analysis determined five relatively pure factors, while the MDS permitted graphic depiction of the solution in a two dimensional figure. The FA and MDS methods proved effective in analyzing the career choice data but different ideas about underlying structure of the instrument would be obtained depending on the method used. (DWH)

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# ASSESSING THE DIMENSIONALITY OF SURVEY DATA

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## Introduction

A pilot questionnaire was constructed for the purpose of investigating various aspects of the career choices made by graduate students. The areas of interest included perceptions of various career fields, motivations for career choices, influences on career decisions, and perceived attributes of careers.

As is typical in constructing surveys of this type, several a priori content areas were postulated and items were written deliberately to address these areas. For example, statements were developed to collect data on such career choice issues as humanitarian versus materialistic orientation, the importance of job security, job status, independence, work environment, and opportunity for personal fulfillment, etc.

A wealth of literature exists in the area of vocational interests and career choices, but the primary focus of that research has been on data collected from occupational interest inventories administered to high school seniors. The efforts have been both to predict careers that students would choose and to help them decide which occupations would be appropriate for them. The focus of the present research, in contrast, was on students enrolled in graduate/professional programs at a large public university. Because these students already had made relatively firm career committments, the interest was in determining their career needs or values and the importance that they placed on various career attributes. Thus, an eventual goal was to develop a new instrument to measure the career choice attitudes of graduate students.

The primary objective of the present research was to attempt to determine the underlying structure of the items comprising the pilot questionnaire. A secondary objective was to compare two popular analytic techniques, nonmetric multidimensional scaling (MDS) and linear factor analysis (FA), in terms of their respective abilities to "discover" the dimensions being measured by the instrument. Other goals of the study were to identify any existing subsets of items that could later serve as subscales and to provide evidence in support of the construct (factorial) validity of the instrument.

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The rationale behind the comparison of MDS with FA lay in the differences between the two models and the respective assumptions made by each about the data. Linear FA is a vector model based on variance decomposition, and it assumes that the variables have continuous distributions and linear relationships both with each other and with the derived factors. In contrast, MDS is a model based on distances among variables represented as points in multidimensional space. Nonmetric MDS makes no distributional assumptions, simply using the rank ordering of measures of proximity among the variables to position them in the space. Generally, one would expect survey item response data to match the weak assumptions of MDS more closely than the stricter assumptions of FA, although FA has long been the traditional method of choice.

One difference between MDS and FA that is commonly observed in practice is that MDS usually results in a lower dimensional solution than does FA of a given set of data. It is frequently an advantage to be able to present graphically the two- or three-dimensional configuration resulting from MDS, while the higher dimensional solution from factor analysis cannot be visualized directly (Shepard, 1972; Schiffman, Reynolds, & Young, 1981). Another advantage of MDS is its greater flexibility in interpretation of the results; interpretations may be based on directional axes through the configuration of variables, on items that cluster together, or on meaningful regions or partitions of the space. Interpretations of FA results, in contrast, must be based strictly on linear vectors at various angles to each other in space. In practice, it is easier to understand the meaning of distances among points in space than the meaning of angles between vectors.

In discussing the research that has compared the results of factor analysis to those of nonmetric MDS for a given set of data, Davison (1983) notes that the studies have been empirical rather than systematic, analytical ones. (The present study is no exception.) As a result, not a great deal is known about the similarities and/or differences that should be expected. However, he does indicate three possible reasons for reaching different conclusions based on these two methods: 1) different matrices of input coefficients are often used, 2) different experimental procedures may be used, sometimes using different variables, and 3) FA and MDS are based on two different mathematical models used to relate the final spatial coordinates of the variables to the original data.

Regarding this last point, the correlation coefficients in FA are represented spatially as factor loadings that together define a vector for each variable, the distance between any two variables being a function of the length of two vectors and the angle between them (Baird & Noma, 1978). MDS, on the other hand, represents the input proximity coefficients in terms of coordinates that locate each variable as a point in space, the distance between any two variables being (usually) a simple Euclidean one. Given the differences between the FA and MDS models, one would not generally expect similar solutions. Although Davison (1983) found a close correspondence between principal components solutions in three dimensions (unrotated) and MDS solutions in two dimen-

sions, these results could not be generalized to solutions having higher dimensionality, to solutions using the principal factors method, or to MDS analyses using other than correlation coefficients as input data.

## METHOD

### Instrumentation

An initial set of about 60 prospective items was written by graduate students as part of a major project in a course on methods of survey research. The students then prescreened the items to eliminate duplication, to improve the phrasing of the items, to ensure that all the desired content areas were represented, and to check for double-barreled items. The experimental form of the survey was then constructed and prepared for pilot testing. The pilot form had 29 statements dealing with career choices plus a section of items to collect background/biographic data. The 29 statements all used the same five-choice Likert type response format with the alternatives ranging from "strongly agree" to "strongly disagree." A copy of the survey instrument is attached as Appendix A.

### Sample

The survey was distributed by campus mail to a systematic sample of 200 graduate students whose names were selected from the student directory. This sample represented about two percent of the graduate student population at the University of Texas at Austin. Of the 200 students contacted, only 135 completed and returned the questionnaire. However, the breakdowns of respondents in terms of background variables such as gender, degree classification, and academic major were approximately representative of the known values of these variables for the population. Still, the purpose of the survey was primarily to collect pilot data that could be used to revise the instrument, so no claim was made that the sample was a truly representative one.

### Factor Analysis

The 29 X 29 item intercorrelation matrix was factor analyzed using the iterative principal axis (common) factoring method from the SAS computer package (1982). Squared multiple correlations were used as initial estimates of the communalities. Both orthogonal and oblique rotations of the factors were specified in running the analysis. To attempt to determine the number of factors to retain, both the "eigenvalues greater than one" rule and the scree plot criterion were used. Although it was recognized that the ratio of observations to variables was substantially smaller than the often cited rule of thumb (10 to 1), and that the solution would probably be an unstable one, still it was hoped that some meaningful structure could be identified. The objective of the factor analysis was to obtain evidence supporting the construct (factorial) validity of the instrument. Specifically, it was hoped that

the factor analysis results would confirm the a priori content areas as constituting the factors being measured by the instrument.

Multidimensional Scaling

Guttman's facet theory approach (see Levy, 1981, for an excellent treatment) was used as the basis for the MDS analysis. The facet theory method expresses regional hypotheses about the space of the MDS solution in the form of a mapping sentence. Because these hypotheses may be specified a priori, being based on a careful inspection and systematic classification of the variables being analyzed, and because predictions can be made about the roles that will be played by each facet, the facet approach may be considered to be a (nonmetric) confirmatory one. However, it does not have to be. Often it is difficult to predict the role that a facet will play before the analysis has been conducted. Thus, an empirical inspection of the final configuration may be necessary to identify the facets, to determine the roles they play in partioning the space, and to construct the mapping sentence.

Briefly, there are three fundamental types of facets: those whose elements are ordered, those whose elements are unordered, and those whose elements are partially ordered. Also, facets may play four types of roles: polar, modular, axial, and joint. Role refers to the way in which the facet may be predicted to partition the solution space into meaningful regions. For example, an unordered facet can be expected to play a polar role, dividing, say, a two-dimensional space into "slices of a pie." As another example, an ordered facet in two dimensions might play a modular role in dividing the space with concentric circles surrounding the origin, or concentric spheres if there were three dimensions. Unordered facets may also play axial roles if the facets are uncorrelated. In such an instance, say in two dimensions, the two facets would form a two-way grid that divided the space into rectangles. Numerous combinations of different types of facets are possible, depending on the mapping sentence that expresses the regional hypotheses.

Guttman has argued that one major facet of the mapping sentence should be a classification of the variables according to the three types of human behavior: affective, cognitive, and instrumental (1982). The items included on the career choice survey, however, were all attitudinal statements in the affective domain, so the mapping sentence did not include this major facet. Even still, at least one facet must reflect a classification of the variables being analyzed, the classification being based on a subjective examination of the features or characteristics of the variables. Therefore, the 29 statements were scrutinized in an attempt to define potential facets along which they varied. Sometimes it can be helpful in this task to form a set of mutually exclusive and jointly exhaustive categories that, taken together, might comprise a facet. If the effort is successful, it should be possible to classify every variable into just one of the categories. Admittedly, this process tends to be much more an art than a science unless the researcher has considerable experience. Frequently it is possible to extrapolate from the basic laws of facet theory that have been demonstrated by

Guttman and his colleagues to write mapping sentences for a particular experimental context. The mapping sentence constructed for the career choice statements is shown below.

Facet A

| | | |
|---|---|---|
| | conventional (work ethic) | |
| The | unconventional (entrepreneurial) | values of graduate student (X) |
| | nonconformist (anti-work ethic) | |

Facet B

| | | |
|---|---|---|
| | personal fulfillment | |
| toward | job fulfillment | needs of career fields ⟶ |
| | materialistic fulfillment | |

| | | |
|---|---|---|
| (is mapped from ) | very positive to very negative | toward that career attribute. |

Each of the two facets in this mapping sentence contains three elements that have a natural ordering. Facet A reveals a progression from traditional to actively non-traditional career values, and Facet B demonstrates movement from highly personal, individualized needs to more universal economic needs. Furthermore, there is no prior reason to believe that these two facets should be correlated. For example, a person with nonconformist career values might still be expected to have all three types of needs listed in Facet B. Therefore, a given attitude statement from the career choice survey could be cross-classified into any level of Facet A and into any level of Facet B, similar to the subjects assigned to a two-way factorial design in analysis of variance. In the situation of two uncorrelated facets, each having ordered elements, the regional hypotheses of facet theory predict that the facets will play axial roles in partitioning the solution space. This structure, having just two dimensions, forms what Guttman refers to as a duplex (a special case of a multiplex).

To test this hypothesized structure, a proximity coefficient matrix of the associations among the 29 statements from the career choice survey was input to the ALSCAL procedure in the SAS computer package. Because of the restrictive assumptions of Pearson correlation coefficients, it was decided to use a nonmetric measure of proximity. The dissimilarities among all pairings of the 29 statements were calculated as the square root of the sum of squared differences between responses to the items, summing across persons. In other words, if, for any person, the response to one statement were the same as the response to

another statement, and this were true for all persons for these two statements, then the dissimilarity coefficient would be equal to zero. Solutions were requested in from one to six dimensions so that stress and R-squared criteria of fit could be observed for each solution. Similar to the factor analytic approach, one objective was to "discover" the number of meaningful dimensions underlying the 29 career choice statements in the solution space. Regarding the facet theory approach, another objective was to test the regional hypotheses expressed in the mapping sentence, both in terms of the roles played by the facets and in terms of classifying the statements into the appropriate elements of the facets.

## RESULTS AND DISCUSSION

### Factor Analysis

Based on the number of factors with eigenvalues greater than one as well as on the location of the elbow in the scree plot, it was found that there were five factors underlying the career choice statements. The five factors accounted for 88% of the common variance among the variables but only about 42% of the total variance. It was observed, however, that there were three variables with very low final communality estimates. Also, these same variables, items 12, 13, and 22, did not have primary loadings on any of the five factors. Therefore, it was decided to discard these three statements from the eventual final form of the career choice survey. The factor analysis was rerun with these variables deleted. The intercorreltion matrix among the 26 remaining statements is shown in Table 1.

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Insert Table 1 about here.

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The reanalysis still showed there to be five factors, as can be seen by the scree plot in Figure 1. The factors now accounted for approximately 93% of the common variance.

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Insert Figure 1 about here.

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The five retained factors were rotated using the varimax criterion to help identify the statements with primary loadings on each of the factors and to facilitate the interpretation of the factors. Surprisingly, the labeling of the factors turned out to be quite straightforward. Based on inspections of the statements all having high loadings on a given factor, it was relatively easy to surmise the general construct that they seemed to be measuring. The rotated factor pattern matrix is shown in Table 2, along with the labels assigned to each of the factors. The interested reader will want to refer to the actual items from the

career choice survey listed in Appendix A to judge the reasonableness of the factor labels.

Insert Table 2 about here.

All of the statements loading on the first factor reflected personal fulfillment needs such as exercising one's creativity, contributing to society, matching one's aptitudes and abilities to the demands of a career, and being challenged by a career. All of the statements on factor two indicated a need for autonomy in a career, such as having control over one's time, having independence, and being one's own boss. The third factor, labeled hedonism, was bi-polar; located at the negative end of the continuum was need for intellectual stimulation in a career, while the items located at the positive end represented more mundane, material needs like high job demand, amount of money earned, job mobility opportunities, ample free time, and good location. The fourth factor represented the job status and security dimension of career needs. The fifth factor also was bi-polar, indicating needs for working with the general public at one end and needs for more private work interactions at the other end.

Because there was good reason to believe that the career choice factors might be correlated with each other, the factor pattern matrix was submitted to the PROMAX oblique rotation method in the SAS package. The results indicated that the only factor intercorrelation of any size ($r=+.24$) was between factors three and four, the hedonism and job status/security factors, which was not surprising. Although the sizes of the factor loadings for the items changed slightly under oblique rotation, the patterns of loadings and the factor structure remained the same.

Multidimensional Scaling

The initial ALSCAL analyses were run on the 29 X 29 proximity matrix among the career choice statements, with solutions specified in from one to six dimensions. Interestingly, it was found that the same three variables with low communality estimates in the factor analysis (items 12, 13, and 22) appeared to be outliers in the MDS spatial configuration. In other words, their coordinates positioned these items near the extreme outer region of the solution space. Therefore, it was decided to remove these items from the MDS analysis, just as had been done for the FA method.

The proximity matrix containing the square roots of the sum of squared differences among the remaining 26 variables is shown in Table 3. These were dissimilarity measures of proximity, in which large numbers indicated much dissimilarity between any two items at a time. The goal of the MDS algorithm was to represent these dissimilarities in terms of distances between the locations of the items in the solution space, where a large dissimilarity would be mapped into a large distance.

Insert Table 3 about here.

The results of performing the MDS analyses in from one to six dimensions on 26 variables were plotted to observe changes in Kruskal's stress (a fit criterion ranging from 0.0 to 1.0) as a function of increasing dimensionality. This plot is shown in Figure 2. Unlike the FA scree plot, where the number of factors to retain is recommended to be one less than where the elbow occurs, the dimensionality of an MDS solution may be indicated exactly where the elbow occurs, if an elbow exists at all. Although the FA scree plot and the MDS stress plot may look similar, they represent entirely different concepts. For the present data, there was no obvious sharp elbow in the plot that appears in Figure 2, although a moderate elbow occurred at the two-dimensional solution, where stress was equal to .11.

Insert Figure 2 about here.

While the stress plot is one indicator of the proper number of dimensions to choose for an MDS solution, the absolute size of the stress value is also important. For the so-called "stress ordinary conditions" (Kruskal & Wish, 1978), it is recommended that a solution be chosen where the stress statistic is less than .10. However, McCallum (1981) has shown that the presence of sampling and/or measurement error in the input data can cause stress to be higher than .10 even when an adequate solution has been obtained. Also, error in the data will tend to mask the occurrence of an elbow in a stress plot (Kruskal & Wish, 1978).

Finally, while stress levels and elbows in stress plots can be useful indicators of dimensionality, the ultimate criterion is interpretability. Because the mapping sentence hypothesized that the career choice data could be represented adequately in two dimensions, because the stress in two dimensions was close to .10, and because a slight elbow appeared at two dimensions, it was decided to attempt an interpretation of the two-dimensional configuration. The coordinates that located the 26 career choice statements in the solution space are shown in Table 4.

Insert Table 4 about here.

In most MDS analyses the coordinate axes of the solution have no interpretable meaning in and of themselves. They merely serve to locate the variables in space, so they are usually ignored during the interpretation phase. In the case of axial facets that form a duplex, however, Guttman (1982) has found that the directions of the facets often correspond to the coordinate axes. Exactly that result was obtained in the solution shown in Figure 3. The two facets that were specified in the mapping sentence correspond to the horizontal and vertical direction in the solution space, Dimensions I and II from Table 4, respectively.

Insert Figure 3 about here.

Based on the examination and classification of the 26 statements relative to the elements of the two facets, dividing lines were drawn to partition each facet, forming the regions of the space represented in Figure 3. Note that the labels for the elements of each facet are also shown as row and column headings. The number corresponding to each statement from the career choice instrument has been indicated to show the location of each statement in the solution space. Generally speaking, the elements of the two facets divided the solution space into interpretable, intuitively meaningful regions, all of which contained statements appropriate for the region based on the content of the statements and the meanings of the elements of the facets. Again, however, the reader will need to consult the actual items listed in Appendix A to judge the reasonableness of the categorizations.

To assist in this endeavor, the labels assigned to the elements of each facet need to be explained in greater detail. Starting with facet A (the vertical dimension), Conventional refers to those career values commonly associated with working for a large corporation, for example, where the traditional work ethic values are emphasized. The statements classified into this element include challenging work, problem solving, high job demand and easy job mobility, monetary rewards, job security, interaction mostly with professionals and other co-workers, and satisfactory geographic location. The element labeled Unconventional describes values that are somewhat non-traditional and reflect an entrepreneurial orientation. For example, items classified into this element include being your own boss, having good fringe benefits (rather than money), enjoying the respect of the public, and placing priority on personal, intellectual values. The Nonconformist element of facet A represents values that are almost anti-work ethic in flavor, where the relevant items include controlling one's own time, being independent, helping others, and not being concerned with job status.

Moving next to facet B (the horizontal dimension in Figure 3), the Materialistic Fulfillment element denotes the basic (usually economic) rewards of working or, in many ways, the quality of life when off the job. The Job Fulfillment element refers to working conditions when on the job or to the work environment. Finally, the Personal Fulfillment element involves the very personal, individualistic needs that may be fulfilled in one's work.

Thus, the facet approach to the MDS analysis performed very well. As predicted, two orthogonal dimensions were needed to accommodate the proximities among the 26 career choice statements, and these dimensions corresponded to two axial facets. The ordered elements of the facets partitioned the solution space appropriately in that the categorizations of statements into the regions made sense intuitively.

## CONCLUSIONS

Both the FA and the MDS methodologies performed very well in meeting the objectives of the present research. Both methods were able to determine an "underlying structure" for the items comprising the career choice instrument, although the structure depended on the method: the FA yielded five relatively pure, empirical factors of the items while the MDS facet theory approach demonstrated the existence of two basic facets of the items. From the standpoint of collecting pilot data on a survey so that revisions to the instrument could be made, both methods identified the same three statements as candidates for item deletion. Also, both methods yielded results that could be interpreted reasonably (within the context of each method) as providing evidence to support the construct validity of the instrument.

One advantage of the MDS over the FA method was that the solution could be depicted graphically in a two-dimensional figure. On the other hand, one advantage of the FA over the MDS method was the identification of five separate, relatively pure factors on which factor scores could be provided for survey respondents to represent their respective positions along the factor continua. No direct counterpart would be possible with the MDS analysis, although a rectangular analysis might be performed to attempt to locate persons in the same space as the items, which would enable persons to be classified into regions depending on their career values and needs. In conclusion, one would have to say that both the FA and MDS methods proved effective in analyzing the career choice data but that different ideas about the underlying structure of the instrument would be obtained depending on the method used.

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Table 1

Intercorrelation Matrix of Career Survey Items

| Item | I1 | I2 | I3 | I4 | I5 | I6 | I7 | I8 | I9 | I10 | I11 | I14 | I15 | I16 | I17 | I18 | I19 | I20 | I21 | I23 | I24 | I25 | I26 | I27 | I28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I2 | 36 | | | | | | | | | | | | | | | | | | | | | | | | |
| I3 | 20 | 42 | | | | | | | | | | | | | | | | | | | | | | | |
| I4 | 09 | 16 | 19 | | | | | | | | | | | | | | | | | | | | | | |
| I5 | 28 | 37 | 35 | 32 | | | | | | | | | | | | | | | | | | | | | |
| I6 | 20 | 58 | 43 | 52 | 42 | | | | | | | | | | | | | | | | | | | | |
| I7 | 04 | 13 | 37 | 18 | 02 | 30 | | | | | | | | | | | | | | | | | | | |
| I8 | 10 | 15 | -04 | 10 | -01 | 10 | 18 | | | | | | | | | | | | | | | | | | |
| I9 | 30 | 24 | 11 | 12 | 37 | 13 | -15 | 02 | | | | | | | | | | | | | | | | | |
| I10 | -17 | 00 | 03 | 19 | 28 | 15 | 03 | 17 | 16 | | | | | | | | | | | | | | | | |
| I11 | -25 | -03 | -04 | 16 | 13 | 16 | 13 | -01 | 06 | 35 | | | | | | | | | | | | | | | |
| I14 | -20 | -15 | -10 | 06 | 03 | -09 | 17 | -06 | -02 | 21 | 51 | | | | | | | | | | | | | | |
| I15 | -29 | -17 | -12 | 02 | 12 | -13 | -09 | -14 | 03 | 27 | 31 | 48 | | | | | | | | | | | | | |
| I16 | -06 | -07 | 07 | 06 | -16 | -02 | 29 | 15 | -00 | 16 | 22 | 30 | 15 | | | | | | | | | | | | |
| I17 | -21 | -25 | -12 | -04 | -01 | -15 | 08 | -04 | -10 | 09 | 40 | 40 | 35 | 33 | | | | | | | | | | | |
| I18 | -01 | 15 | 03 | 06 | -08 | 05 | -04 | 02 | -03 | 07 | -17 | -24 | -25 | -17 | -27 | | | | | | | | | | |
| I19 | 02 | -14 | -01 | -05 | -12 | -06 | 23 | 16 | -10 | -06 | 11 | 12 | 12 | 37 | 31 | -40 | | | | | | | | | |
| I20 | 08 | -10 | -07 | -01 | 20 | -11 | -30 | -05 | 30 | 13 | -04 | 04 | 17 | 02 | 19 | -09 | -02 | | | | | | | | |
| I21 | -06 | -09 | 28 | -02 | -16 | 11 | 50 | -07 | -16 | -02 | 03 | 06 | -01 | 25 | 03 | -09 | 30 | -31 | | | | | | | |
| I23 | 07 | 13 | -06 | 06 | -02 | 04 | 09 | 55 | 03 | -03 | 07 | 05 | -07 | 17 | -03 | -02 | 23 | -11 | -09 | | | | | | |
| I24 | -15 | -11 | -07 | 08 | 01 | -07 | 21 | 33 | -08 | 13 | 11 | 20 | 12 | 22 | 09 | -03 | 07 | -03 | 09 | 43 | | | | | |
| I25 | -03 | 01 | -07 | 05 | -05 | -06 | 16 | 43 | 02 | 00 | 01 | 14 | 06 | 31 | 12 | -07 | 17 | 00 | -11 | 59 | 60 | | | | |
| I26 | 13 | 14 | 11 | 19 | 11 | 07 | 03 | 35 | 20 | 07 | 04 | -01 | 04 | 08 | -20 | -01 | 08 | 04 | -13 | 47 | 09 | 31 | | | |
| I27 | -06 | -09 | 05 | 13 | 04 | 05 | 07 | -17 | -08 | -14 | 21 | 25 | 18 | 26 | 45 | -29 | 33 | 14 | 11 | -14 | -16 | -01 | -11 | | |
| I28 | -20 | -18 | -13 | -03 | -11 | -03 | 05 | -08 | -08 | 09 | 07 | 27 | 18 | 18 | 13 | 14 | -04 | -11 | 08 | 04 | 43 | 19 | -03 | -02 | |
| I29 | -25 | -20 | -16 | 14 | -06 | 01 | 05 | 07 | -03 | 19 | 31 | 32 | 23 | 36 | 24 | -21 | 29 | -06 | 03 | 24 | 26 | 24 | 07 | 14 | 34 |

Note: Table entries have two implied decimals and have been rounded off to hundredths.

Table 2

Varimax Rotated Factor Loading Matrix

| Item | I | II | III | IV | V |
|---|---|---|---|---|---|
| 1 | .38 | .10 | -.40 | .04 | -.11 |
| 2 | .63 | .09 | -.23 | -.12 | -.00 |
| 3 | .56 | -.08 | -.13 | .08 | .28 |
| 4 | .47 | .08 | .17 | -.02 | .03 |
| 5 | .68 | -.07 | .11 | .02 | -.27 |
| 6 | .77 | -.02 | .00 | -.07 | .20 |
| 7 | .30 | .16 | .09 | .12 | .66 |
| 8 | .09 | .63 | -.08 | -.01 | .05 |
| 9 | .39 | .08 | .01 | -.02 | -.40 |
| 10 | .23 | .01 | .46 | -.09 | -.12 |
| 11 | .17 | -.02 | .59 | .20 | -.03 |
| 14 | -.02 | .01 | .65 | .25 | .02 |
| 15 | -.07 | -.08 | .51 | .21 | -.16 |
| 16 | -.01 | .29 | .32 | .35 | .21 |
| 17 | -.14 | -.05 | .46 | .48 | -.06 |
| 18 | .03 | -.03 | -.10 | -.55 | .08 |
| 19 | -.07 | .24 | -.00 | .66 | .22 |
| 20 | .04 | -.05 | .08 | .16 | -.51 |
| 21 | .03 | -.08 | -.01 | .15 | .66 |
| 23 | .00 | .80 | -.02 | .05 | -.01 |
| 24 | -.11 | .55 | .36 | -.15 | .18 |
| 25 | -.08 | .74 | .13 | .04 | .02 |
| 26 | .23 | .45 | -.08 | .02 | -.17 |
| 27 | .05 | -.18 | .16 | .57 | .02 |
| 28 | -.15 | .12 | .41 | -.21 | .17 |
| 29 | -.08 | .28 | .49 | .21 | .04 |

| Factor: | Label: |
|---|---|
| I | Personal Fulfillment |
| II | Autonomy |
| III | Hedonism |
| IV | Status/Security |
| V | Public/Private |

Table 3

Proximity Matrix of Career Survey Items

| Item | I1 | I2 | I3 | I4 | I5 | I6 | I7 | I8 | I9 | I10 | I11 | I14 | I15 | I16 | I17 | I18 | I19 | I20 | I21 | I23 | I24 | I25 | I26 | I27 | I28 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| I2 | 86 | | | | | | | | | | | | | | | | | | | | | | | | |
| I3 | 103 | 91 | | | | | | | | | | | | | | | | | | | | | | | |
| I4 | 102 | 106 | 107 | | | | | | | | | | | | | | | | | | | | | | |
| I5 | 110 | 103 | 105 | 105 | | | | | | | | | | | | | | | | | | | | | |
| I6 | 94 | 74 | 88 | 81 | 98 | | | | | | | | | | | | | | | | | | | | |
| I7 | 150 | 140 | 120 | 135 | 149 | 128 | | | | | | | | | | | | | | | | | | | |
| I8 | 136 | 133 | 147 | 136 | 154 | 136 | 146 | | | | | | | | | | | | | | | | | | |
| I9 | 104 | 107 | 117 | 115 | 104 | 113 | 162 | 147 | | | | | | | | | | | | | | | | | |
| I10 | 245 | 223 | 213 | 210 | 200 | 215 | 203 | 211 | 208 | | | | | | | | | | | | | | | | |
| I11 | 294 | 268 | 258 | 255 | 249 | 259 | 234 | 260 | 257 | 157 | | | | | | | | | | | | | | | |
| I14 | 283 | 263 | 251 | 250 | 245 | 259 | 222 | 254 | 251 | 165 | 125 | | | | | | | | | | | | | | |
| I15 | 257 | 239 | 229 | 225 | 218 | 236 | 217 | 236 | 224 | 158 | 158 | 133 | | | | | | | | | | | | | |
| I16 | 268 | 249 | 235 | 239 | 244 | 246 | 206 | 230 | 241 | 164 | 158 | 144 | 160 | | | | | | | | | | | | |
| I17 | 294 | 277 | 263 | 264 | 258 | 272 | 238 | 262 | 266 | 181 | 141 | 138 | 154 | 146 | | | | | | | | | | | |
| I18 | 234 | 210 | 207 | 207 | 212 | 211 | 197 | 211 | 212 | 165 | 189 | 187 | 185 | 174 | 196 | | | | | | | | | | |
| I19 | 231 | 219 | 205 | 211 | 211 | 214 | 179 | 200 | 213 | 175 | 171 | 161 | 158 | 136 | 155 | 182 | | | | | | | | | |
| I20 | 209 | 198 | 191 | 189 | 177 | 196 | 199 | 198 | 176 | 157 | 187 | 174 | 155 | 168 | 169 | 162 | 158 | | | | | | | | |
| I21 | 268 | 251 | 227 | 242 | 244 | 241 | 191 | 242 | 249 | 185 | 181 | 169 | 174 | 150 | 181 | 169 | 142 | 194 | | | | | | | |
| I23 | 192 | 176 | 182 | 176 | 184 | 181 | 171 | 142 | 178 | 192 | 205 | 198 | 194 | 177 | 212 | 175 | 155 | 173 | 199 | | | | | | |
| I24 | 230 | 216 | 207 | 203 | 205 | 213 | 179 | 187 | 210 | 173 | 187 | 171 | 172 | 161 | 188 | 170 | 163 | 168 | 173 | 141 | | | | | |
| I25 | 207 | 191 | 189 | 186 | 191 | 193 | 168 | 161 | 188 | 181 | 200 | 180 | 176 | 157 | 190 | 170 | 153 | 160 | 191 | 112 | 113 | | | | |
| I26 | 141 | 133 | 132 | 130 | 138 | 137 | 150 | 130 | 129 | 192 | 230 | 223 | 201 | 209 | 242 | 188 | 179 | 167 | 222 | 132 | 183 | 150 | | | |
| I27 | 193 | 181 | 167 | 166 | 169 | 172 | 165 | 190 | 180 | 183 | 182 | 170 | 163 | 163 | 163 | 180 | 136 | 142 | 178 | 173 | 181 | 161 | 166 | | |
| I28 | 153 | 153 | 150 | 143 | 154 | 144 | 151 | 165 | 151 | 197 | 236 | 215 | 199 | 211 | 232 | 184 | 195 | 184 | 217 | 171 | 161 | 165 | 151 | 167 | |
| I29 | 171 | 167 | 161 | 145 | 159 | 154 | 158 | 159 | 157 | 181 | 207 | 197 | 185 | 186 | 212 | 199 | 162 | 174 | 212 | 151 | 166 | 154 | 147 | 151 | 129 |

Note: Table entries have one implied decimal and have been rounded off to tenths.

Table 4

Coordinates of Final MDS Configuration

| Item | Dimensions | |
|---|---|---|
| | I | II |
| 1 | 2.07 | .02 |
| 2 | 1.68 | -.05 |
| 3 | 1.45 | -.01 |
| 4 | 1.45 | .13 |
| 5 | 1.36 | .46 |
| 6 | 1.56 | .05 |
| 7 | .81 | -.55 |
| 8 | 1.37 | -.51 |
| 9 | 1.47 | .32 |
| 10 | -.96 | .89 |
| 11 | -2.08 | .67 |
| 14 | -1.91 | .30 |
| 15 | -1.42 | .66 |
| 16 | -1.67 | -.20 |
| 17 | -2.19 | .49 |
| 18 | -.83 | -.97 |
| 19 | -1.00 | -.07 |
| 20 | -.41 | .60 |
| 21 | -1.63 | -.88 |
| 23 | .09 | -.65 |
| 24 | -.78 | -.70 |
| 25 | -.30 | -.48 |
| 26 | .86 | -.09 |
| 27 | -.18 | .38 |
| 28 | .79 | -.13 |
| 29 | .40 | .32 |

Figure 1

Scree Plot for Factor Analysis of Career Choice Survey

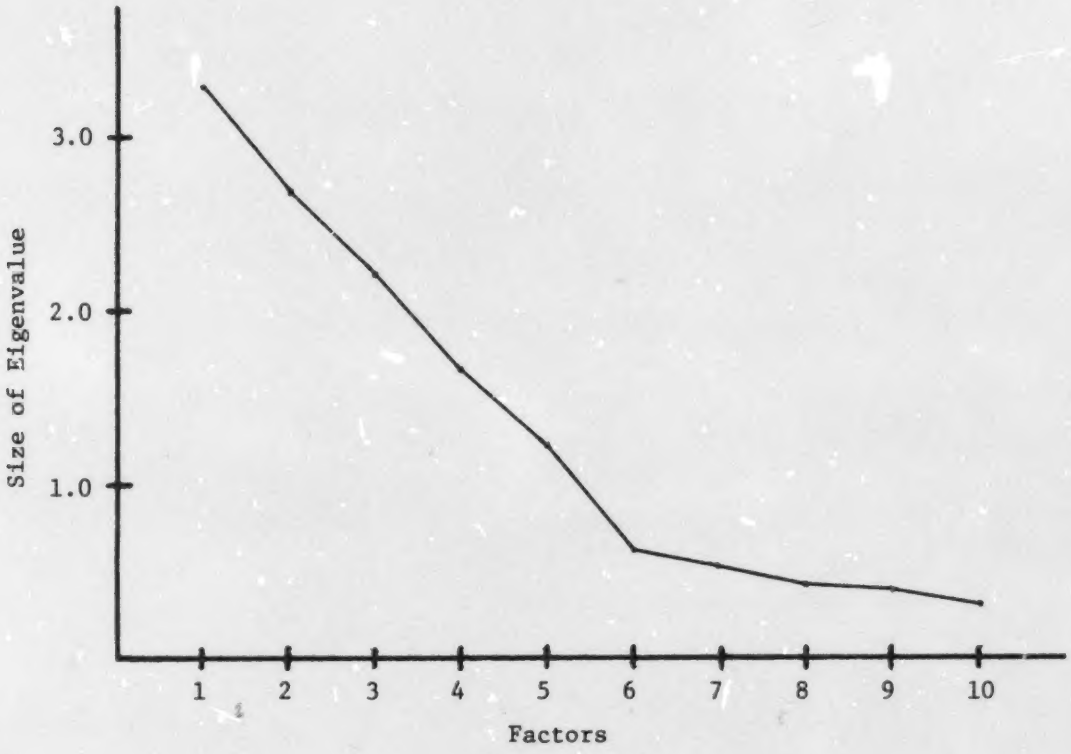



Figure 2

ALSCAL Stress vs. Number of Dimensions

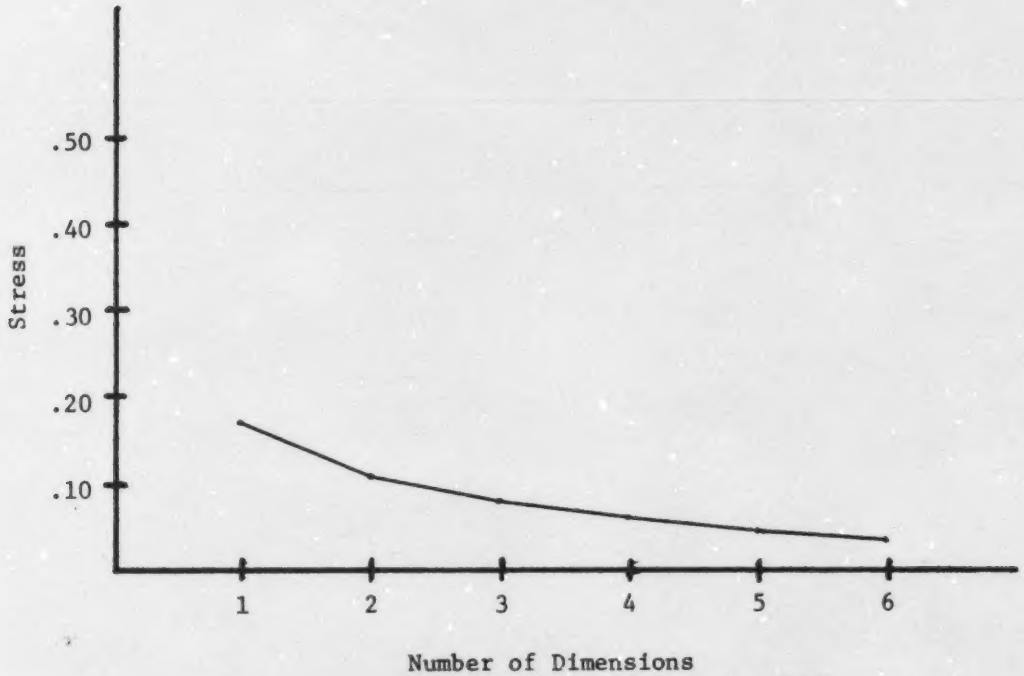
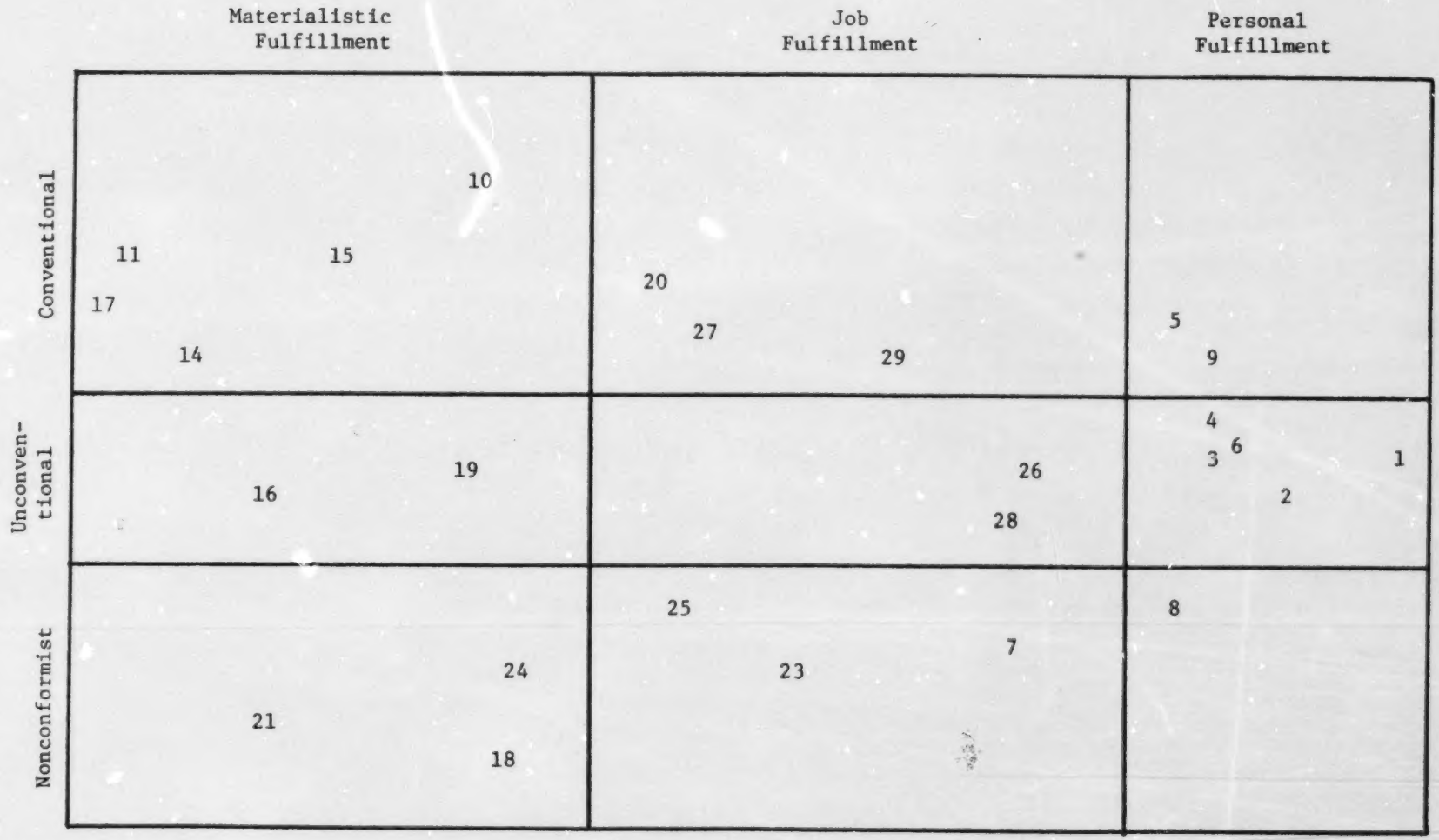


Figure 3

Duplex Solution for Career Choice Survey Items



## Career Choice Survey

Directions: For each of the statements listed below, place a check mark in the appropriate box to indicate your personal feelings. Although in most cases you may not yet have a particular job in mind, respond in terms of the career field for which your graduate program is aimed.

| | | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|---|
| 1. | I chose my career for the intellectual stimulation it offered. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 2. | Through my career, I can exercise my creativity. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 3. | I feel that I will be able to make a contribution to society through my career. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 4. | I chose my career because I have good aptitude for it. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 5. | I chose my career because I knew it would be challenging. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 6. | I feel that my individual abilities will be effectively utilized in my career. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 7. | My career gives me an opportunity to be personally helpful to others. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 8. | One thing I like about my career is its opportunity for independence. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 9. | A career that emphasizes problem solving is important to me. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 10. | Job mobility was an important factor in my career choice. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 11. | The job demand for people in my career field was an important factor in my career choice. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 12. | A close relative had an influence on choice of a career. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 13. | A professional member of my chosen field influenced my career choice. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 14. | The amount of money I will make was important to my career choice. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 15. | I prefer a career in which my income is directly related to the amount of work I do. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 16. | Fringe benefits were an important factor in my career choice. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 17. | I purposely chose a career having a reputation for long-term job security. | ☐ | ☐ | ☐ | ☐ | ☐ |

-continued on back-

| | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| 18. Job status had little effect on my career selection. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 19. I deliberately chose a career field that is well-respected by the general public. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 20. I prefer jobs where interaction is mostly with co-workers and other professionals. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 21. I chose my particular career because I wanted to work mainly with the general public. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 22. An important aspect of my career is the chance to work with sophisticated technical equipment. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 23. I purposely chose a career in which I will be able to set my own hours. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 24. The amount of leisure time that a particular career offered was important to my choice. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 25. When choosing my career, an important factor was having control over the amount of time spent on the job. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 26. I would like to be my own boss. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 27. Job security will be an important factor in my eventual job selection. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 28. I do not want a job that demands all my time. | ☐ | ☐ | ☐ | ☐ | ☐ |
| 29. An important factor in the job I choose will be its geographic location. | ☐ | ☐ | ☐ | ☐ | ☐ |

## Background Information

Classification: ☐ Master's degree ☐ Doctoral degree ☐ Law degree

Marital Status: ☐ Married ☐ Single

Date of birth: ☐☐ mo. ☐☐ day ☐☐ yr.

Sex: ☐ Female ☐ Male

Department in which you are currently a student: _____

Desired type of employment: _____

Citizenship status: ☐ U.S. citizen ☐ Foreign student

(USE ENCLOSED ENVELOPE TO RETURN BY CAMPUS MAIL)

ABSTRACT

Assessing the Dimensionality of Survey Data

A Likert type questionnaire was developed and pilot tested with the objective of measuring various aspects of the career choices made by graduate students. The areas of interest included motivations for career choices, influences on career decisions, and perceived attributes of various careers. Two competing analytic techniques, nonmetric multidimensional scaling and linear factor analysis, were compared in terms of their respective abilities to determine the underlying dimensions being measured by the instrument. Both techniques were found to provide useful information about the structure of the questionnaire, but the information was of different kinds. The factor analysis determined five relatively pure factors, while the multidimensional scaling discovered two basic facets of the survey items.